REMARKS

Careful consideration has been given to the Official Action of May 29, 2002 and reconsideration of the application as amended is respectfully requested.

The substitute specification has been amended to correct two minor typographical errors.

The Examiner has rejected claims 1-4, 6-11, 13-18 and 20 on a combination of Kinsman, et al. in view of Terashima. The remaining claims have been rejected on this combination with additional references.

Amendatory action has been taken in the claims in order to clearly distinguish over the Kinsman and Terashima references thereby avoiding the rejection under 35 U.S.C. § 103.

In particular, the claims have been amended in order to set forth the characteristic of the invention that instead of encapsulating the heat sink and facing the attendant problems associated therewith (as will be explained subsequently), the heat sink is connected by adhesive glue to the die pad and a portion of the leads wherein the adhesive glue is thermally conductive and electrically insulating. Thereby, the heat sink is exposed to the ambient

atmosphere and is not encapsulated in the encapsulant.

Kinsman shows a semiconductor package, which puts a heat sink inside the lower mold (see Fig. 1A) before it is encapsulated. On the contrary, the heat sink of the present invention is outside the encapsulant and is attached to the die pad and leads with a thermally conductive and electrically insulating adhesive glue. The disadvantages of the Kinsley patent is what the invention seeks to overcome (see the summary of the invention), and these are:

(1) Since the heat sink and the encapsulant have different CTE (Coefficient of Thermal Expansion), when the structure of the Kinsman patent is exposed to expansion and shrinking, the effect of thermal stress at the contact surface between the heat sink and the encapsulant will produce delamination at the contact surface.

(2) The amounts of the encapsulant inside the upper mold and lower mold are not the same, and the package structure of Kinsman will become warped due to different shrinkage amounts after cooling. The moisture in the atmosphere will permeate into cracks caused by delamination or warping, and the reliability of the semiconductor package will be reduced.

(3) The structure of the Kinsman patent nas greater thickness due to containing the heat sink in the encapsulant, and this is not suitable for thin

products having a thickness less than 1.00 mm.

Terashima discloses a curved peripheral portion of a package, which is used for resolving cracking problems of a conventional package. The construction is substantially different from the present invention. The citation of the die pad in Terashima does not relate to the basic deficiency noted above in Kinsman.

Yamashita discloses protruding portions on the periphery of the chip, and the backside of the chip has an adhered heat sink, The patent was cited for its heat radiator but in other respects is entirely different in construction and objectives.

In view of the above action and comments, it is respectfully submitted that the claims are now patentably distinguished over the cited art and favorable reconsideration of the application is earnestly solicited.

Respectfully submitted,

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Marked-up Copy of the Specification

Fig. 1 shows the DHS (Drop-in Heat Sink) structure of a semiconductor package disclosed in U.S. Patent No. [5,22,710] 5,225,710. The package's structure comprises: a die a pad 14; a die 12, which is attached to a first surface 141 of the die pad 14 with a suitable adhesive 15, such as a silver paste; a plurality of leads 13 electrically connected to an active surface 121 of the die 12 by a plurality of bonding wires 17, such as gold wires; a heat sink 16 and an encapsulant 11. The die pad 14 and the plurality of leads 13 are all a part of a leadframe and are placed inside an upper mold 18 during manufacture. The heat sink 16 is located inside a lower mold 19, and one surface of the heat sink 16 contacts the bottom of the lower mold 19 with points 161 and 162. Another surface of the heat sink is attached to the second surface 142 and the die pad 14.

Page 3, amend paragraph 4 as follows:

In use, the known semiconductor packages described above provide heat dissipation paths which extend from the die 12, through the die pad 14, to the heat sinks 16 or 21, and finally to the atmosphere. These heat dissipation paths are too limited because the plurality of leads are not used for dissipating the heat, reducing the efficiency of their heat dissipation.

Marked-up Copy of th Claims

1. (Amended) A semiconductor package for enhancing heat dissipation, comprising:

a die having an active surface;

a leadframe, including:

a die pad having a first surface and a second surface, said die being attached to said first surface of the die pad; and

a plurality of leads electrically connected to the active surface of said die, said leads having a surface;

an encapsulating sealing said die and at least a portion of the surface of the leads in said leadframe; and

a heat sink attached to the second surface of said die pad and at least a portion of the surface of leads in said plurality of leads with a thermally conductive and electrically insulating adhesive glue, said heat sink being exposed to ambient atmosphere and not encapsulated in said encapsulant.

8. (Amended) A semiconductor package for enhancing heat dissipation, comprising:

a die having an active surface and a second surface;

a lead frame; including:

a central-hole die pad having a first surface and a second surface, said first surface being attached to said die; and

a plurality of leads electrically connected to the active surface of said die,

said leads having a surface;

an encapsulant sealing one portion of the surface of said plurality of leads [in] and said die [and] in said leadframe; and

a heat sink having a T-type structure including a portion extending in a hole of said die pad and attached to said second surface of said die by a thermally conductive and electrically insulating adhesive glue, said heat sink also being attached to [the second surface of said die,] the second surface of said die pad and at least another portion of the surface of leads in said plurality of leads with [a] said thermally conductive and electrically insulating adhesive glue, said heat sink being exposed to ambient atmosphere and not encapsulated in said encapsulant.

13. (Amended) The semiconductor package of claim 8, manufactured by steps of:

(a) attaching said die to the first surface of said die pad, and electrically connecting the active surface of said die to the plurality of leads;

(b) adding an encapsulant to an upper mold for sealing said die and one portion of the surface of said plurality of leads;

(c) attaching said heat sink to the second surface of said die, the second surface of said die pad and at least another portion of the surface of leads in said plurality of leads with [a] said thermally conductive and electrically insulating adhesive glue; and

(d) forming and singulating said leadframe.

15. (Amended) A semiconductor package for enhancing heat dissipation, comprising:

a die having an active surface;

a plurality of leads electrically connected to the active surface of said die, said leads having a surface;

an encapsulant sealing said die and one portion of the surface of said leads; and

a heat sink attached to at least another portion of the surface of leads in said plurality of leads with a thermally conductive and electrically insulating adhesive glue, said heat sink being exposed to ambient atmosphere and not encapsulated in said encapsulant.

20. (Amended) A method of manufacturing a semiconductor package comprising the steps of:

(a) electrically connecting the active surface of a die to a plurality of leads;

(b) adding encapsulant to an upper mold for sealing said die and one portion of the surface of leads in said plurality of leads; and

(c) attaching said heat sink to another portion of the surface of at least some leads in said plurality of leads with thermally conductive and electrically insulating adhesive glue, said heat sink being exposed to ambient atmosphere and not encapsulated in said encapsulant.